REMARKS

This communication is a full and timely response to the non-final Office Action dated July 16, 2004, the period for response being extended because October 16, 2004 was a Saturday. By this communication, claims 1-12 have been amended and claims 13 and 14 have been added.

Claim 1 has been amended to improve idiomatic English and to recite energy calculating means for calculating local energy of said original image based on two rows of pixels in said original image. Support for the changes to claim 1 can be found variously throughout the drawings and specification, for example, in Fig. 9 and page 19, line 22 through page 20, line 15. No new matter has been added.

Claims 2, 3, and 5-7 have been amended to improve idiomatic English and address formal issues, where applicable. No new matter has been added.

Claim 4 has been amended to recite performs a one-dimensional filtering process through a one-dimensional edge building filter such that the value of each pixel is multiplied by a corresponding coefficient of a of a plurality of coefficients and the products of each respective multiplication are added together, and wherein the one-dimensional edge building filter coefficients include a scaling factor. Support for the changes to claim 4 can be found variously throughout the specification, for example, at page 21, line 16 through page 22, line 20. No new matter has been added.

Claim 8 has been amended to recite said consistency judging means determines that a value obtained by multiplying a first difference and a second difference is negative, wherein the first difference is obtained by subtracting the new pixel value from the pixel value of a pixel located at the center of the upper row, and wherein the second difference is obtained by subtracting the pixel value of a pixel located at the center of the lower row from the new pixel value. Support for the changes to claim 8 can be found variously throughout the specification, for example, at page 24, lines 6-10 and page 25, lines 5-20. No new matter has been added.

Claim 9 has been amended to recite calculates local energy of said original image by subtracting pixel values of pixels located in a right column of the original image from corresponding pixel values of pixels located in a left column of the original image, calculating an absolute value for each pixel value difference, and calculating a sum of the absolute values, wherein the pixels in

the right column of the original image are diagonally spaced from the corresponding pixels in the left column of the original image. Support for the changes to claim 9 can be found variously throughout the specification, for example, at page 36, lines 19-25. No new matter has been added.

Claim 10 has been amended to recite said interpolation performed by said interpolation means is at least one of a first interpolation and second interpolation, and when the value of Z is equal to or greater than 2, said interpolation means performs the first interpolation and said edge enhancement means performs the edge enhancement, until Z is less than 2, and when the value of Z is smaller than 2 said interpolation means performs the second interpolation and said edge enhancement means performs the edge enhancement. Support for the changes to claim 10 can be found variously throughout the drawings and specification, for example, in Figs. 2 and 3, page 14, lines 12-25, and page 15, line 22 through page 16, line 2. No new matter has been added.

Each of claims 11 and 12 have been amended to recite calculating local energy of said original image based on two rows of pixels in said original image. Support for the changes to claims 11 and 12 can be found variously throughout the drawings and specification, for example, in Fig. 9 and page 19, line 22 through page 20, line 15. No new matter has been added.

Claims 13 and 14 have been added. Support for the subject matter recited in claims 13 and 14 can be found variously throughout the drawings and specification, for example, at page 36, lines 19-25. No new matter has been added.

Claims 1-14 are pending where claims 1, 11, and 12 are independent.

Rejections Under 35 U.S.C. §112

Claims 1, 2, 4, 5, and 10-12 were rejected under 35 U.S.C. §112, first paragraph for allegedly failing to comply with the written description requirement. Regarding claims 1, 4, 5, and 10-12, the Office Action alleges that the recited "edge enhancement means" is not described in a way to reasonably convey that the inventors had possession of the claimed invention at the time of filing. Regarding claim 2, the Office Action alleges that the terms "loose connection" and "tight connection" are not clearly defined. Applicant respectfully traverses this rejection.

The edge enhancement means as recited in the above-noted claims corresponds, for example, to the vertical edge builder 17 and horizontal edge builder 18 as shown in Fig. 1. As described in the specification, the vertical edge builder 17 and horizontal edge builder 18 filter

image data in the vertical and horizontal directions to **edge-enhance** the image and remove remaining errors (see page 12, lines 5-8). For at least this reason, the claimed edge enhancement means is adequately described in the specification. Accordingly, Applicant respectfully requests that the rejection of claims 1, 4, 5, and 10-12 under §112, first paragraph be withdrawn.

The "loose connection" and "tight connection" are associated with the high speed zooming process, as shown in Fig. 3, and particularly with determining the image mode of the original image. As described in the specification at page 15, lines 10-15 and page 47, lines 10-15, "loose connection" describes a small-size image that makes enlargement difficult because the image has a low resolution and includes a small amount of reliable information (see page 11, lines 1-3), e.g. icons and fonts. An edge-connection process must be performed on the "loose connection" image because of the low resolution and minimal amount of reliable information. On the other hand, a "tight connection" image is one that has a high resolution and a sufficient amount of reliable information such that the edge connection process need not be performed (see page 15, lines 19-22. For at least these reasons, the claimed "loose connection" and "tight connection" are adequately described in the specification. Accordingly, Applicant respectfully requests that the rejection of claim 2 under §112, first paragraph be withdrawn.

Claims 2, 3, 8, and 10 were rejected under 35 U.S.C. §112, second paragraph for alleged indefiniteness. In particular, the Office Action alleges that in claim 2 the terms "loose connection' and "tight connection" are not clearly recited. Moreover, regarding claim 3, the Office Action alleges that the recited "said energy conversion means" lacks antecedent basis. Still further, regarding claim 8 the Office Action alleges the basis for judging the consistency of an image as recited in the claim is unclear. Finally, the Office Action alleges that "processes which are to be performed" lacks antecedent basis and the processes to be performed based on the value of Z as recited in the claim is unclear.

As discussed above, the "loose connection" and "tight connection" as recited in claim 2, describes the quality of the original image and whether the edge connection process must be performed on the original image. If the original image is a loose connection, the edge connection process is required to convert the original image to a tight connection. The Office Action alleges that the calculation of local energy is required prior to performing the edge connection process.

However, the specification discloses that in performing the edge connection process the right diagonal energy and the left diagonal energy must be determined (see page 48, lines 1-8). The local energy is calculated when performing, for example, the high-speed vertical up sampling process. Applicant notes that the high-speed vertical up sampling is performed on tight connection images (see page 15, lines 19-24; Fig. 9). Thus, it follows that the local energy calculation is based on the diagonal energy (right, left). Therefore, it is clear from the specification that the right diagonal energy and left diagonal energy associated with the edge connection process is not analogous to the local energy. For at least these reasons, "loose connection" and "tight connection" are sufficiently described in the specification and the loose connection to tight connection conversion process as recited in the claims is definite. Accordingly, Applicant respectfully requests that rejection of claim 2 under §112, second paragraph be withdrawn.

Regarding claim 3, Applicant has amended claim 3 to recite "edge conversion means." Accordingly, Applicant respectfully requests that the rejection of claim 3 under §112, second paragraph be withdrawn.

Regarding claim 8, the interpolation performed by based on the judged consistency is clear and definite. For example, the consistency judging means determines the consistency of an interpolated pixel. Based on a comparison of the interpolated pixel to the pre-existing pixels, the judging means determines whether the consistency of the interpolated pixel is negative. If the consistency is negative, a linear interpolation is then performed to interpolate a new pixel (see page 25, line 5 through page 26, line 12). For at least these reasons, the consistency judging as recited in claim 8 is clear and definite. Accordingly, Applicant respectfully requests that the rejection of claim 8 under §112, second paragraph be withdrawn.

As discussed above, claim 10 has been amended to recite said interpolation performed by said interpolation means is at least one of a first interpolation and second interpolation, and when the value of Z is equal to or greater than 2, said interpolation means performs the first interpolation and said edge enhancement means performs the edge enhancement, until Z is less than 2, and when the value of Z is smaller than 2 said interpolation means performs the second interpolation and said edge enhancement means performs the edge enhancement. For at least this reason, the alleged

antecedent and definiteness issues are resolved. Accordingly, Applicant respectfully requests that the rejection of claim 10 under §112, second paragraph be withdrawn.

Rejections Under 35 U.S.C. §102

Claims 1, 5-7, 11, and 12 were rejected under 35 U.S.C. §102(e) as anticipated by *Aoyama et al.*, U.S. Patent No. 6,535,651. Applicant respectfully traverses this rejection.

Claim 1 recites an image processing apparatus for converting the resolution of an original image in such a manner as to increase the spatial resolution of said original image by a factor of Z in each of vertical and horizontal directions, said image processing apparatus comprising energy calculating means for calculating local energy of said original image based on two rows of pixels in said original image; detection means for detecting the direction of an edge based on said local energy calculated by said energy calculating means; interpolation means for interpolating a new pixel from a pixel of said original image based on the direction of the edge detected by said detection means; and edge enhancement means for performing an edge enhancement process based on said local energy calculated by said energy calculating means.

Claim 11 recites an image processing method of converting the resolution of an original image in such a manner as to increase the spatial resolution of said original image by a factor of Z in each of vertical and horizontal directions, said image processing method comprising the steps of calculating local energy of said original image based on two rows of pixels in said original image; detecting the direction of an edge based on said local energy calculated in said energy calculating step; interpolating a new pixel from a pixel of said original image based on the direction of the edge detected in said detection step; and performing an edge enhancement process based on said local energy calculated in said energy calculating step.

Claim 12 recites a storage medium storing a computer-readable program for controlling an image processing apparatus to convert the resolution of an original image in such a manner as to increase the spatial resolution of said original image by a factor of Z in each of vertical and horizontal directions, said program comprising the steps of calculating local energy of said original image based on two rows of pixels in said original image; detecting the direction of an edge based on said local energy calculated in said energy calculating step; interpolating a new pixel from a

pixel of said original image based on the direction of the edge detected in said detection step; and performing an edge enhancement process based on said local energy calculated in said energy calculating step.

In summary, independent claims 1, 11, and 12 recites an apparatus, method, and program, respectively, that convert the resolution of an original image in such a manner as to increase the spatial resolution of said original image by a factor of Z in each of vertical and horizontal directions by, among other things, calculating local energy of said original image based on two rows of pixels in said original image. Using two rows of pixels in the original image provides an easier way for calculating local energy, in that the local energy is determined from the interpolation of a value between the pixel values of two pixels located in upper and lower pixel rows, respectively. As further recited, these two pixels are positioned diagonally from each other relative to the two pixel rows. In addition, using two rows of pixels enables processing that enlarges an edge in the vertical direction or horizontal direction.

Aoyama discloses an interpolating method and apparatus for processing image signals. The interpolating apparatus has an edge presence or absence judging means 31, a first interpolation operating means 40, and a second interpolating operating means 50. The edge presence or absence judging means 31 determines whether the interpolation point belongs to an edge portion or a flat portion. The first interpolating operation means 40 specifies the direction along which the image edge portion extends, and divides a unit lattice of the image into triangular regions with image edge serving as the boundary between the regions. The second interpolating operating means 50 inputs an instruction that alters the sharpness of a flat portion of the image along the exterior of the image. The interpolating method further calculates two an image density gradient vectors I and J. The difference between I and J is compared with a predetermined threshold value so that the direction along which the image portion of the image extends can be specified.

Aoyama, however, fails to disclose, teach, or suggest at least calculating local energy of said original image based on two rows of pixels in said original image, as recited in claims 1, 11, and 12. In contrast, *Aoyama* discloses that the image density is calculated from the unit lattice, and an edge determination is then performed. When the edge presence or absence judging means 31 determines

that the image has no edge portion, the process of the second interpolating operating means 50 is carried out. In other words, *Aoyama* does not perform any edge enhancement operations.

To properly anticipate a claim, the document must disclose, explicitly or implicitly, each and every feature recited in the claim. *See* Verdegall Bros. v. Union Oil Co. of Calif., 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). *Aoyama* fails to disclose, teach, or suggest every element recited in independent claims 1, 11, and 12, therefore these claims are not anticipated by *Aoyama*. Accordingly, Applicant respectfully requests that the rejection of claims 1, 11, and 12 under 35 U.S.C. §102 be withdrawn, and these claims be allowed.

Claims 5-7 depend from claim 1. By virtue of this dependency, Applicant submits that claims 5-7 are allowable for at least the same reasons given above with respect to claim 1. In addition, Applicant submits that claims 5-7 are further distinguished over *Aoyama* by the additional elements recited therein, and particularly with respect to each claimed combination. Applicant respectfully requests, therefore, that the rejection of claims 5-7 under 35 U.S.C. §102 be withdrawn, and these claims be allowed.

Rejections Under 35 U.S.C. §103

Claims 2 and 3 were rejected under 35 U.S.C. §103(a) as unpatentable over *Aoyama* and further in view of *Klassen*, U.S. Patent No. 6,741,751. Applicant respectfully traverses this rejection.

Claims 2 and 3 depend from claim 1. By virtue of this dependency, Applicant submits that claims 2 and 3 are allowable for at least the same reasons given above with respect to claim 1. In addition, Applicant submits that claims 2 and 3 are further distinguished over *Aoyama* and *Klassen* by the additional elements recited therein, and particularly with respect to each claimed combination. Applicant respectfully requests, therefore, that the rejection of claims 2 and 3 under 35 U.S.C. §103 be withdrawn, and these claims be allowed.

Claim 4 was rejected under 35 U.S.C. §103 as unpatentable over *Aoyama* and further in view of *Moronaga et al.*, U.S. Patent No. 5,229,864. Applicant respectfully traverses this rejection.

Claim 4 depends from claim 1 and additionally recites when said local energy is greater than a predetermined threshold value, said edge enhancement means performs a one-dimensional

filtering process through a one-dimensional edge building filter such that the value of each pixel is multiplied by a corresponding coefficient of a plurality of coefficients and the products of each respective multiplication are added together, and wherein the one-dimensional edge building filter coefficients include a scaling factor. The Office Action acknowledges that *Aoyama* fails to disclose, teach, or suggest at least the elements of claim 4 and relies on *Moronaga* to remedy this deficiency.

Moronaga discloses that a one-dimensional filter, wherein the respective products of each multiplication are summed. Moreover, *Moronaga* discloses that the one dimensional filtering process is performed based on the amount of coded data Bxy. *Moronaga*, however, fails to disclose, teach, or suggest at least when said local energy is greater than a predetermined threshold value, said edge enhancement means performs a one-dimensional filtering process. In contrast, *Moronaga* discloses that the amount of coded data Bxy corresponds to the many high frequency components and coded data within the individual blocks of an 8x8 matrix. Applicant submits that the amount of coded data as disclosed by *Moronaga* is not analogous to the local energy of a pixel. Basing the one-dimensional filter process on the local energy, as recited in claim 4, has the advantage of enabling the filtering process to be adapted for the surrounding pixels.

In summary, *Aoyama* and *Moronaga* either singly or combined fail to disclose teach or suggest at least when said local energy is greater than a predetermined threshold value, said edge enhancement means performs a one-dimensional filtering process. At best, the combined references teach performing a one-dimensional filtering process when the amount of data within the individual blocks of an 8x8 matrix is greater than a predetermined threshold TH3. The disclosed amount of data of the references is not analogous to the local energy as recited in the claim. Accordingly, a *prima facie* case for obviousness has not been established.

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Moreover, obviousness "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." ACS Hosp. Sys. V. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). For at least the above reasons, Applicant respectfully requests that the rejection of claim 4 be withdrawn, and claim 4 be allowed.

Claim 8 was rejected under 35 U.S.C. §103(a) as unpatentable over *Aoyama* and further in view of *Yamashita et al.*, U.S. Patent No. 5,513,281. Applicant respectfully traverses this rejection.

Claim 8 depends from claim 1 and additionally recites said consistency judging means determines that a value obtained by multiplying a first difference and a second difference is negative, wherein the first difference is obtained by subtracting the new pixel value from the pixel value of a pixel located at the center of the upper row, and wherein the second difference is obtained by subtracting the pixel value of a pixel located at the center of the lower row from the new pixel value.

The Office Action acknowledges that *Aoyama* fails to disclose, teach, or suggest the elements recited in claim 8, and relies on *Yamashita* to remedy this deficiency.

Yamashita discloses an interpolating method and apparatus that determines whether a contradiction exists in the pixel level difference between pixel levels in both diagonal directions as compared to the vertical level difference. *Yamashita*, however, fails to disclose teach or suggest at least calculating local energy of said original image based on two rows of pixels in said original image, as recited in claim 1. Moreover, based on the elements recited in claim 8, the present invention uses a 2-D filter that can be decomposed to a 1-D filter. The filter coefficients of the 1-D filter depend on a scaling factor that is indicated by the user. This scaling factor is between 0.5 and 1.4 ($0.5 \leq x \leq 1.4$). For at least this reason, *Yamashita* does not remedy the deficiencies of *Aoyama*. Therefore, *Aoyama* and *Yamashita* either singly or combined fails to establish a *prima facie* case for obviousness.

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Moreover, obviousness "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." ACS Hosp. Sys. V. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). For at least the above reasons, Applicant respectfully requests that the rejection of claim 8 be withdrawn, and claim 8 be allowed.

Claim 9 was rejected under 35 U.S.C. §103(a) as unpatentable over *Aoyama* and further in view of *Ng et al.*, U.S. Patent No. 5,450,531. Applicant respectfully traverses this rejection.

Claim 9 depends from claim 1 and additionally recites said energy calculating means creates an energy map having a size corresponding to the size of said original image and calculates local energy of said original image by subtracting pixel values of pixels located in a right column of the original image from corresponding pixel values of pixels located in a left column of the original image, calculating an absolute value for each pixel value difference, and calculating a sum of the absolute values, wherein the pixels in the right column of the original image are diagonally spaced from the corresponding pixels in the left column of the original image.

Ng discloses a resolution enhancement system that creates a gradient map for every pixel in an input image. This gradient map is calculated by taking the square root of the sum of square of the gradient x operator and the square of gradient y operator for each location in the bitmap to produce a gradient magnitude map. In contrast, local energy is calculated from the energy map by subtracting pixel values of pixels located in a right column of the original image from corresponding pixel values of pixels located in a left column of the original image, calculating an absolute value for each pixel value difference, and calculating a sum of the absolute values, wherein the pixels in the right column of the original image are diagonally spaced from the corresponding pixels in the left column of the original image. Thus, the energy gradient as disclosed by *Ng* is not analogous to the energy map as recited in claim 9. In addition, *Ng* fails to disclose, teach, or suggest at least calculating local energy of said original image based on two rows of pixels in said original image, as recited in claim 1. Therefore, the combination of *Aoyama* and *Ng* either singly or combined fail to establish a *prima facie* case for obviousness.

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Moreover, obviousness "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." ACS Hosp. Sys. V. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). For at least the above reasons, Applicant respectfully requests that the rejection of claim 9 be withdrawn, and claim 9 be allowed.

Conclusion

Based on at least the foregoing amendments and remarks, Applicants submit that claims 1-14 are allowable, and this application is in condition for allowance. Accordingly, Applicants request favorable reexamination and reconsideration of the application. In the event the Examiner has any comments or suggestions for placing the application in even better form, Applicants request that the Examiner contact the undersigned attorney at the number listed below.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 18-0013, under Order No. SON-2199 from which the undersigned is authorized to draw.

Dated: October 18, 2004

Respectfully submitted,

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